

## ABSTRACT OF THE DISCLOSURE

A process is disclosed for manufacturing a film that is smooth and has large nitride grains of a diffusion barrier material. Under the process, a nitride of the diffusion barrier material is deposited by physical vapor deposition in an environment of nitrogen. The nitrogen content of the environment is selected at an operating level such that nitride nuclei of the diffusion barrier material are evenly distributed. A grain growth step is then conducted in the nitrogen environment to grow a film of large nitride grains of the diffusion barrier material. Also disclosed is a stack structure suitable for MOS memory circuits incorporating a lightly nitrated refractory metal silicide diffusion barrier with a covering of a nitride of a diffusion barrier material. The stack structure is formed in accordance with the diffusion barrier material nitride film manufacturing process and exhibits high thermal stability, low resistivity, long range agglomeration blocking, and high surface smoothness.

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